Safety and Operations Committee

Board Information Item III-B

Rail Signal Safety Updates

Board Action/Information Summary

○ Action ◉ Information	MEAD Number: 203410	Resolution: ○ Yes ◉ No

TITLE:

Rail Signal Safety Updates

PRESENTATION SUMMARY:

To provide a briefing on why delivering additional safety improvements for the community will require Metro to fully activate the train control system (Automatic Train Operations and Auto Doors).

PURPOSE:

Inform the Board on a key rail signal safety initiative at Metro.

DESCRIPTION:

- Provide overview of how signaling works

- Explain train automation and how we use it here at Metro

- Provide an update on key safety initiatives Metro has implemented since 2009 and the state of operations until we move to a higher grade of automation

- Provide a comparative analysis of Metro's use of signaling

- Share an overview of the anticipated key next steps to return Metro to Grade of Automation 2 (GoA2) operations

- Share an overview of signaling technology being adopted globally by leading transit agencies and US peer agencies to modernize their rail systems

- Provide key dates regarding anticipated next steps and future updates to the board

  Key Highlights:

  - Since opening in 1976, Metro's train control system was designed to operate utilizing automatic mode operations, or grade of automation 2 (GoA2)

- Since 2009, Metro has used manual operations or grade of automation 1 (GoA1)

- Metro has maximized the safety improvements that can be realized without implementing a higher grade of automation for train operations

- GoA2 may help prevent signal overruns. Currently, Metro has instituted administrative and procedural controls which are generally reactive measures

- In the long-term there is a need to modernize the system to help ensure continued safe and reliable operations for the community

Background and History:

A signaling system performs several vital safety functions. Beginning in 2009, Metro has used manual or GoA1 operations, after deactivating the use of automatic train operations throughout the network. During this time, several safety reviews and engineering assessments were conducted to identify improvements the organization needed to implement to promote return to GoA2 operations. Metro's most recent attempt to restart the use of automatic operations in 2019 was halted when it was determined that additional measures were needed to improve the state of repair of the signal infrastructure. Since this time the organization has prioritized funding to address the replacement of track circuits, cables, bonds and other key signal system components. In 2020, the proposal to return to a higher level of automatic train operations was evaluated by the Senior Management Team. It was determined that the state of the infrastructure was being adequately addressed for Metro to begin efforts of restoring the system to its designed mode of operating.

Additionally, since 2009 Metro has implemented a vast number of safety reforms across the organization to address staff competency, operational procedures, and maintenance practices. These reforms, being mostly administrative, have resulted in safer operations for our customers. Metro has maximized the potential improvements that can be realized from the implementation of administrative reforms. To provide optimal safety benefits for the community, Metro should look to implement a preventive engineering solution and return to automatic train operations.

Lastly, as the system continues to age, a full replacement of the train control system should be considered. As seen globally across the transit industry, agencies are moving to signal systems that utilize higher grades of automation to improve on safety and provide a more digitally connected experience for riders and staff, increase reliability of the network, and reduce maintenance cost. As the industry turns to higher grades of automation, it is imperative that Metro take steps to help ensure we can continue to meet the needs of the region.

Discussion:

Human factors are the leading cause of station and red signal overruns. The ability to eliminate overruns is not possible under manual mode operations but can be prevented under a higher grade of automation. Across the globe, Metro looked at 42 other transit systems and found that within their networks eight of the 42 systems operate in manual mode for their entire network. Metro is one of these eight systems. The need to adapt our system to a higher grade of automation is a necessary step to promote safer practices and help provide the optimal experience to the community.

FUNDING IMPACT:

Funding is already allocated for this purpose in the Capital program under CIP 251_14 ATO Restoration for Stations. Total amount funded was $8,088,500. Planning for higher grades of automation is funded, but implementation is not.

Project Manager:	Tiffani Jenkins
Project Department/Office:	Capital Program Delivery, Signaling System Renewal Program

TIMELINE:

Previous Actions	2019 Return to ATO program deferred 2019 ATC State of Good Repair Programs launched - Q4 FY 2021 ATO Restoration for Stations Program Relaunched with EMT approval - Q2 FY2023 – Launched independent engineering review of ATO program
Anticipated actions after presentation	- Submit testing plan to RSSC for approval: Q3 FY2023 - Perform training of testing teams: Q3 FY2023 - Initiate integrated testing on the Redline: Q4 FY2023

Rail Signal Safety Updates

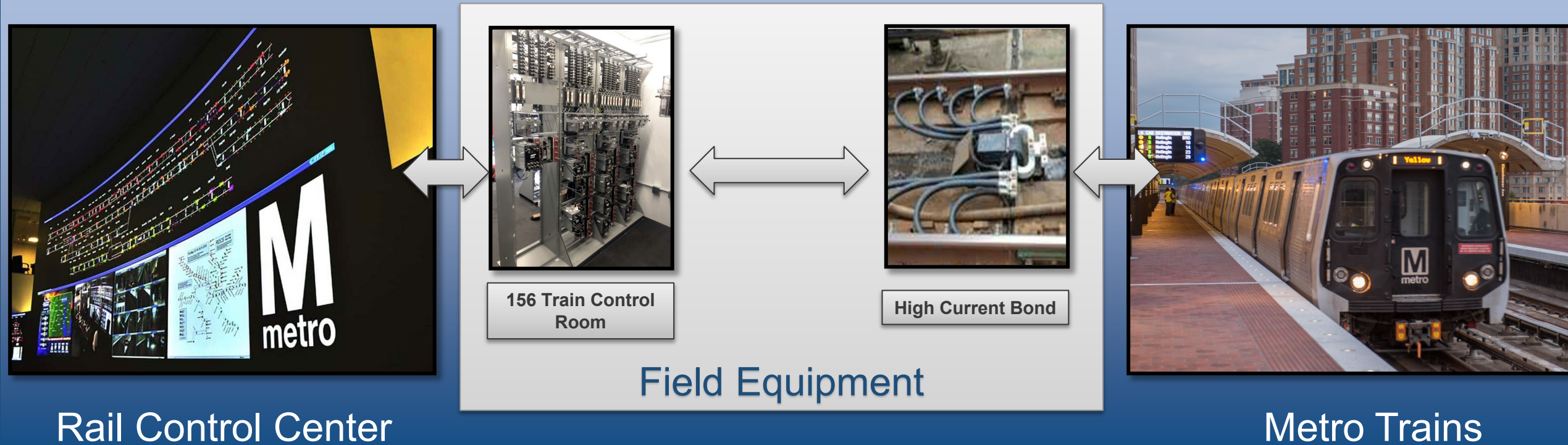Safety & Operations Committee
December 8, 2022

Purpose

To provide a briefing on why delivering additional safety improvements for the community will require Metro to fully activate the train control system (Automatic Train Operations and Auto Doors)

Background and Goals

- Since 1976, Metro's train control system designed to operate utilizing automatic mode operations, or grade of automation 2 (GoA2)

- Since 2009, operating in the degraded mode of manual operation, or grade of automation 1 (GoA1)

- Over the last decade, administrative changes to engineering specifications, maintenance policies and operating practices instituted to help ensure safer operations for the community

- Since 2012, prioritized funding for train control system state of good repair projects to improve system reliability

- To provide further safety improvements Metro intends to restore GoA2 train operations

How Does the Train Control System Work?

156 Train Control Room

High Current Bond

Field Equipment

Rail Control Center

Metro Trains

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Understanding Grade of Automation

GoA1: Train driver controls starting and stopping, operation of doors and handling of emergencies or sudden diversions

GoA2: Starting and stopping are automated, but driver operates the doors, drives the train if needed and handles emergencies

GoA3*: Starting and stopping are automated, but train attendant operates the doors and drives the train in case of emergencies

GoA4*: Starting, stopping and operation of doors are all fully automated without any on-train staff; recommended install station platform screen doors

* Platform doors required

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Improving safety in manual mode (GoA1)

Operational Improvements

- Revamped operator and controller training programs
- Implemented systemwide reduction in maximum operating speeds
- Modified headways to account for longer train safety checks
- Implemented SMS system to improve safety reporting and root cause investigations
- Developed more robust safety awareness programs

Maintenance Improvements

- Replaced all Alstom Gen2 track circuits
- Implemented fall speed restrictions to reduce rail wheel slippage
- Instituted a "Loss of Shunt" tool to identify possible track circuit issues
- Developed more robust preventive maintenance inspection program

Key Factors for Station and Red Signal Overruns

Key Factor Group	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Human Factors	6	3	4	1	2	65	109	87	226	110	67	37
Procedures	2	3	6	3	4	46	62	44	100	33	12	25
Communications	3	0	1	1	2	2	4	4	15	1	2	1
Design	0	0	0	1	0	5	8	0	3	1	0	1
Leadership	1	0	1	0	0	0	0	1	2	0	0	0
Maintenance	0	0	0	0	0	5	7	5	2	1	0	0
Planning	0	0	2	0	0	0	2	1	0	0	0	0
Tools and Equipment	1	0	0	0	1	11	4	11	17	5	5	0
Training	0	1	1	0	1	1	6	3	6	6	0	2
Work Environment	0	0	0	0	0	0	3	5	12	0	2	7
Undetermined	11	124	198	283	370	223	150	158	12	3	1	12

Human factors are the leading cause of station and red signal overruns

What are other Mass Transit Systems Doing?

Metro Reviewed data collected from 42 Community of Metros (COMET) systems

- Over 70% of their routes utilize GoA2 operations or above

- Only 8 of 42 metros operate their entire system using GoA1

  - Metro is one of these 8 systems and the **only** system of the 8 designed for GoA2 at inception

Grade of Automation
% of Route Km, Latest Available Data
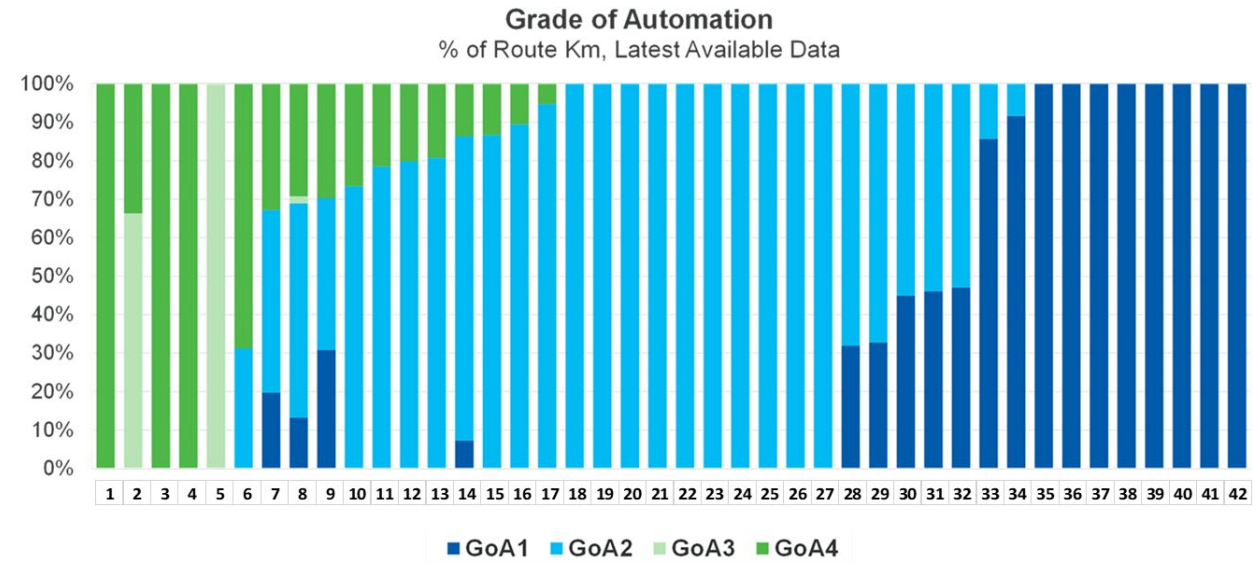
Higher grade of automation enables increased control over train speed and formulation of effective traffic management strategies. It also reduces the chances of mishaps caused by human error.

GoA2 and Auto Door History/Timeline

NTSB Report & FTA Recommendations
NTSB determines GoA2 not root cause; FTA issues Corrective Action Plans to Metro

Return-to-GoA2 Program Relaunched
Program restart for GoA2 during Rush-Hour only approved

Opening Day
Metrorail service began on Red Line in GoA2

GoA2 Trial
Brief trial of GoA2 implemented October 2014

Return-to-GoA2 and Auto Door Programs Launched
Project task order awarded

(Projected) Return-to-GoA2 Launches on Red Line
During Rush-Hour Q4 FY23

| 1976 | 2009 | 2010 | 2014 | 2018 | 2019 | 2021 | 2023 |

Fort Totten Collision, June 2009
GoA2 suspended pending root-cause investigation of accident

GoA2 Study
Evaluation of rush-hour GoA2 begins

Return-to-GoA2 Report
Return to GoA2 During Rush-Hours Report (Mott MacDonald)

Return-to-GoA2 Program Deferred
Auto Door program continued testing and data collection

Auto Door initiative added to GoA2 program
Auto Door relaunch required due to quality issues identified in 2018 data sheets

Program Progress and Schedule

GoA2 and Auto Doors Red Line Installation and Testing	Completion
Red Line Wayside Installation/Testing **(100% verified)**	Complete
MSRPH Updates	Q3 FY23
Red Line Integrated Testing	Q4 FY23
Red Line Operator and Controller Training	Q4 FY23
Red Line Safety Certification	Q4 FY23
Phase 1 ATO&AD Launch	**Q4 FY23**

GoA2 and Auto Doors Other Lines Installation and Testing	Completion
B/O/S/G/Y Wayside Installation/Testing **(~20% verified)**	Q3 FY23
B/O/S/G/Y Integrated Testing	Q1 FY24
B/O/S/G/Y Operator and Controller Training	Q1 FY24
B/O/S/G/Y Safety Certification	Q1 FY24
Phase 2 ATO&AD Launch	**Q2 FY24**

Train Control System (156 Rooms)

27,915 Vital Relay

3225 Track Circuits

1156 Signal

770 Switches
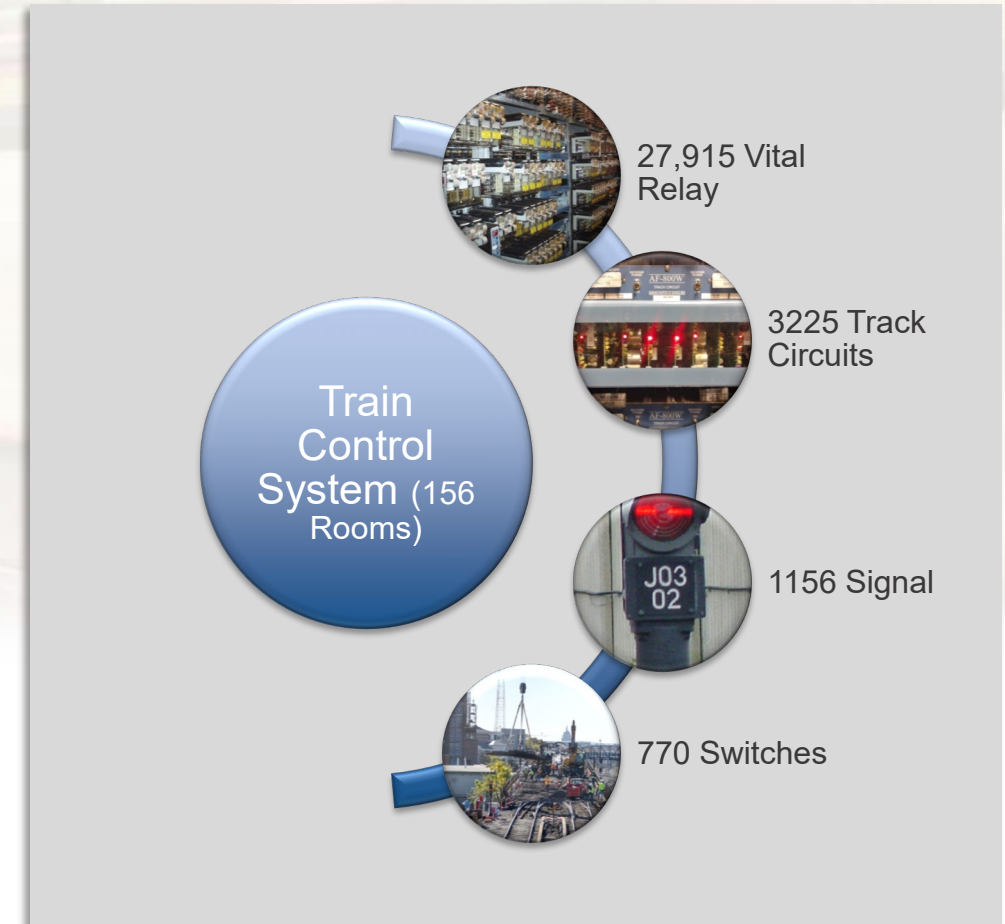
Restoring GoA2 and Auto Door Functions

Safety Certification

- Obtain engineering approval of all cab and field data

- Conduct dynamic testing to verify safe system performance

- Coordinate safety certification review with WMSC

  - November 18, 2022 the WMSC closed the corrective action plan regarding proper implementation of safety certification for project

Staff Coordination

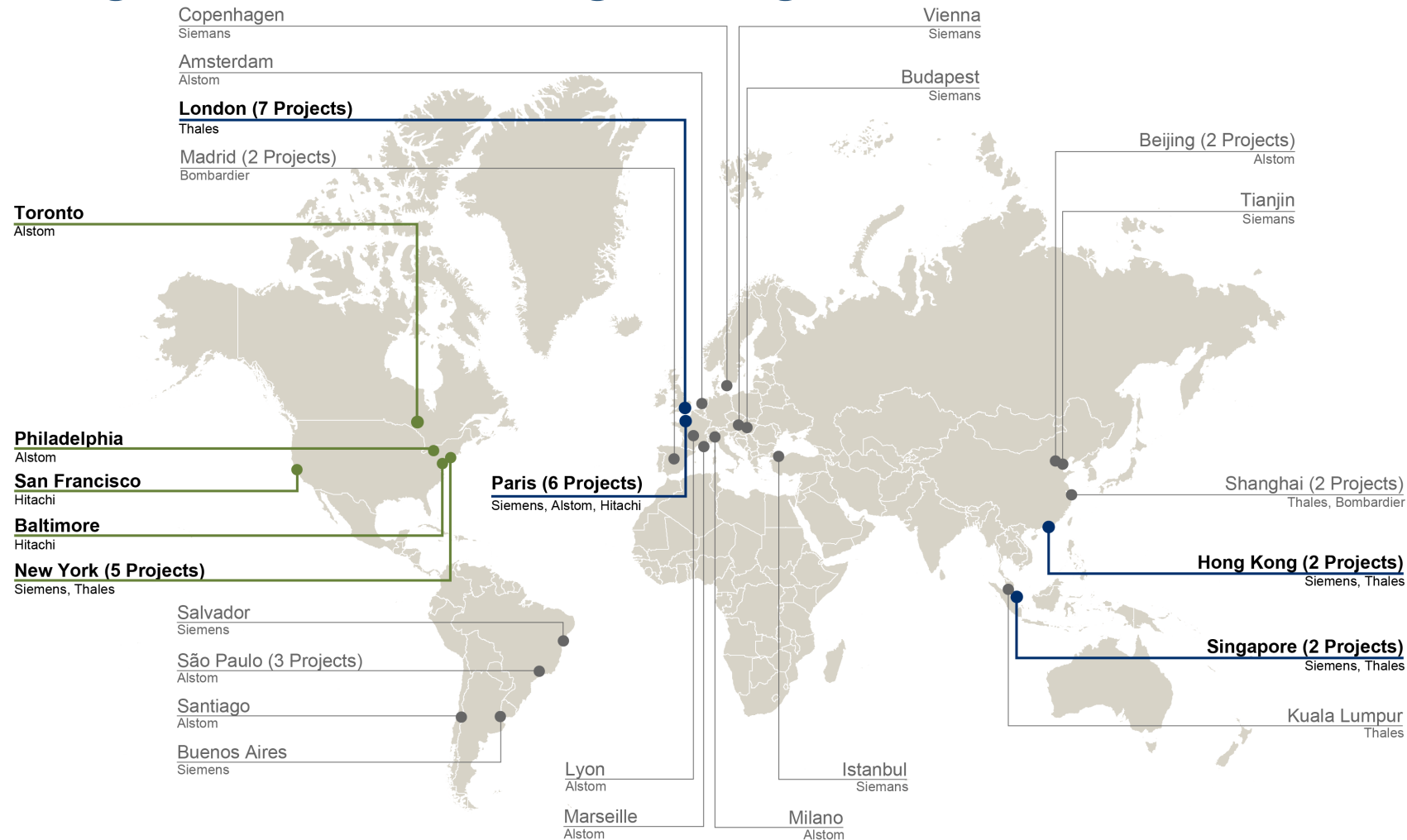- Execute employee engagement campaign on ATO and Auto Door program

- Develop and perform certification training for operations and control room staff

- Execute rule changes to help ensure safe operations in GoA2

- Coordinate sustainability review of power consumption

Readiness Review

- Conduct engineering readiness review

- Conduct APTA Peer review

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Communications-Based Train Control (CBTC) is the next generation of signaling around the Globe

Copenhagen
Siemans

Amsterdam
Alstom

London (7 Projects)
Thales

Madrid (2 Projects)
Bombardier

Toronto
Alstom

Philadelphia
Alstom

San Francisco
Hitachi

Baltimore
Hitachi

New York (5 Projects)
Siemens, Thales

Salvador
Siemens

São Paulo (3 Projects)
Alstom

Santiago
Alstom

Buenos Aires
Siemens

Paris (6 Projects)
Siemens, Alstom, Hitachi

Lyon
Alstom

Marseille
Alstom

Vienna
Siemans

Budapest
Siemans

Istanbul
Siemans

Milano
Alstom

Beijing (2 Projects)
Alstom

Tianjin
Siemans

Shanghai (2 Projects)
Thales, Bombardier

Hong Kong (2 Projects)
Siemens, Thales

Singapore (2 Projects)
Siemens, Thales

Kuala Lumpur
Thales

Next Steps

- **Q4 FY23**: Perform GoA2 testing on redline

- **Q2 FY24**: Board update on the key program initiatives to include the next generation signaling program

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